



US011300736B2

(12) **United States Patent**
Zhang et al.

(10) **Patent No.:** **US 11,300,736 B2**
(45) **Date of Patent:** **Apr. 12, 2022**

(54) **CONNECTOR ASSEMBLY**

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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/902,646**

(22) Filed: **Jun. 16, 2020**

(65) **Prior Publication Data**

US 2020/0393628 A1 Dec. 17, 2020

(30) **Foreign Application Priority Data**

Jun. 17, 2019 (CN) 201910522567.8

(51) **Int. Cl.**
G02B 6/38 (2006.01)

(52) **U.S. Cl.**
CPC **G02B 6/3887** (2013.01); **G02B 6/3893**
(2013.01)

(58) **Field of Classification Search**
CPC G02B 6/3887; G02B 6/3893
USPC 385/85
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,323,480	A *	6/1994	Mullaney	G02B 6/4442
				385/135
5,446,823	A *	8/1995	Bingham	G02B 6/4422
				174/93
5,455,391	A *	10/1995	Demesmaeker	B25B 23/0064
				174/93
5,915,056	A *	6/1999	Bradley	G02B 6/38875
				385/76
6,409,392	B1 *	6/2002	Lampert	G02B 6/3879
				385/56
6,848,834	B1 *	2/2005	Roehrs	G02B 6/383
				385/59
7,137,742	B2 *	11/2006	Theuerkorn	G02B 6/3831
				385/53
7,207,727	B2 *	4/2007	Tran	G02B 6/3825
				385/54
7,780,173	B2 *	8/2010	Mullaney	H02G 3/22
				277/621
9,291,790	B2 *	3/2016	Kimbrell	G02B 6/4471
9,304,262	B2 *	4/2016	Lu	G02B 6/3885
9,513,451	B2 *	12/2016	Corbille	G02B 6/4471
9,678,283	B1 *	6/2017	Chang	G02B 6/3831
10,473,873	B2 *	11/2019	Diepstraten	G02B 6/4446
10,605,998	B2 *	3/2020	Rosson	G02B 6/387

(Continued)

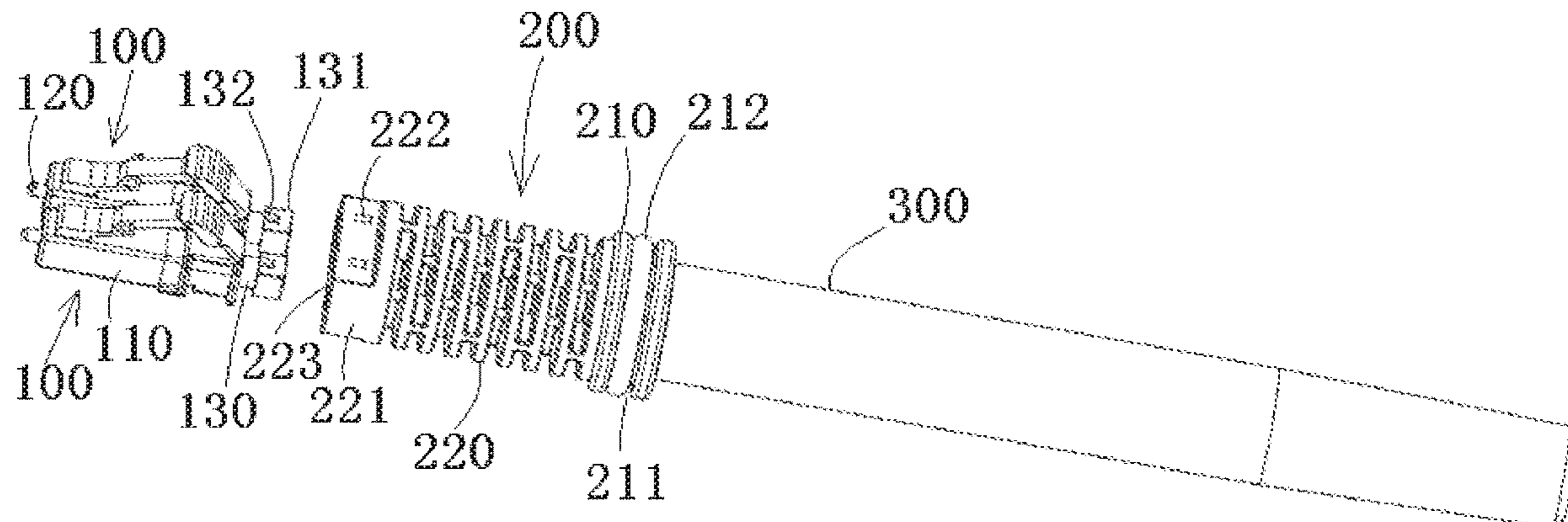
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(57) **ABSTRACT**

A connector assembly includes a connector and a fixing device. The connector has a housing, a ferrule mounted in the housing, and a rear body inserted into a rear end of the housing. The fixing device is connected to the rear body of the connector. The fixing device has a fixture formed in a single integrated piece. The fixture includes a connection part located at a front end of the fixture and configured to be connected to the rear body of the connector and a flexible protection part disposed adjacent to the connection part and configured to protect a cable passing therethrough.

17 Claims, 4 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

10,976,513 B2* 4/2021 Allen G02B 6/4471
 2004/0121646 A1* 6/2004 Iamartino G02B 6/3887
 2005/0213892 A1* 9/2005 Barnes G02B 6/3806
 2006/0115219 A1* 6/2006 Mudd G02B 6/3887
 2007/0104445 A1* 5/2007 Larson G02B 6/3846
 2008/0112672 A1* 5/2008 Lewallen G02B 6/3825
 2008/0232743 A1* 9/2008 Gronvall G02B 6/3897
 2010/0158452 A1* 6/2010 Takahashi G02B 6/2558
 2010/0316344 A1* 12/2010 Bylander G02B 6/3833
 2011/0002586 A1* 1/2011 Nhep G02B 6/3887
 2011/0123157 A1* 5/2011 Belsan H01R 13/516
 2011/0229098 A1* 9/2011 Abernathy G02B 6/4433
 2012/0008909 A1* 1/2012 Mertesdorf G02B 6/3897
 2012/0170896 A1* 7/2012 Skluzacek G02B 6/3889
 2012/0219254 A1* 8/2012 Bradley G02B 6/3885
 2012/0257859 A1* 10/2012 Nhep G02B 6/3888
 2013/0315541 A1* 11/2013 Nhep G02B 6/3869
 2014/0205245 A1* 7/2014 Gallegos G02B 6/3826

2015/0071592 A1* 3/2015 Zimmer G02B 6/3889
 2015/0117822 A1* 4/2015 Hu G02B 6/3849
 2015/0241642 A1* 8/2015 Hikosaka G02B 6/3826
 2015/0338581 A1* 11/2015 Hikosaka G02B 6/3887
 2016/0018605 A1* 1/2016 Ott G02B 6/3821
 2016/0018606 A1* 1/2016 Xue H01R 31/06
 2016/0041356 A1* 2/2016 Wang G02B 6/3821
 2016/0131857 A1* 5/2016 Pimentel G02B 6/4471
 2016/0154184 A1* 6/2016 Bund G02B 6/4452
 2016/0209599 A1* 7/2016 Van Baelen G02B 6/387
 2016/0252682 A1* 9/2016 Watte G02B 6/3846
 2017/0212313 A1* 7/2017 Elenabaas G02B 6/3869
 2017/0336576 A1* 11/2017 Bund G02B 6/3869
 2018/0136427 A1* 5/2018 Theuerkorn G02B 6/4477
 2018/0292618 A1* 10/2018 Chang G02B 6/3887
 2018/0335577 A1* 11/2018 Wong G02B 6/3825
 2018/0341069 A1* 11/2018 Takano G02B 6/3879
 2019/0154930 A1* 5/2019 Ho G02B 6/3887
 2019/0179083 A1* 6/2019 Wang G02B 6/3803
 2019/0219775 A1* 7/2019 Iizumi G02B 6/3893
 2019/0310432 A1* 10/2019 Chang G02B 6/3825
 2019/0377139 A1* 12/2019 Chang G02B 6/3898
 2020/0064564 A1* 2/2020 Ho G02B 6/3893
 2020/0333537 A1* 10/2020 Gniadek G02B 6/3825
 2020/0341208 A1* 10/2020 Verheyden G02B 6/3839
 2021/0141167 A1* 5/2021 Wong G02B 6/3893
 2021/0173150 A1* 6/2021 Nhep G02B 6/3861

* cited by examiner

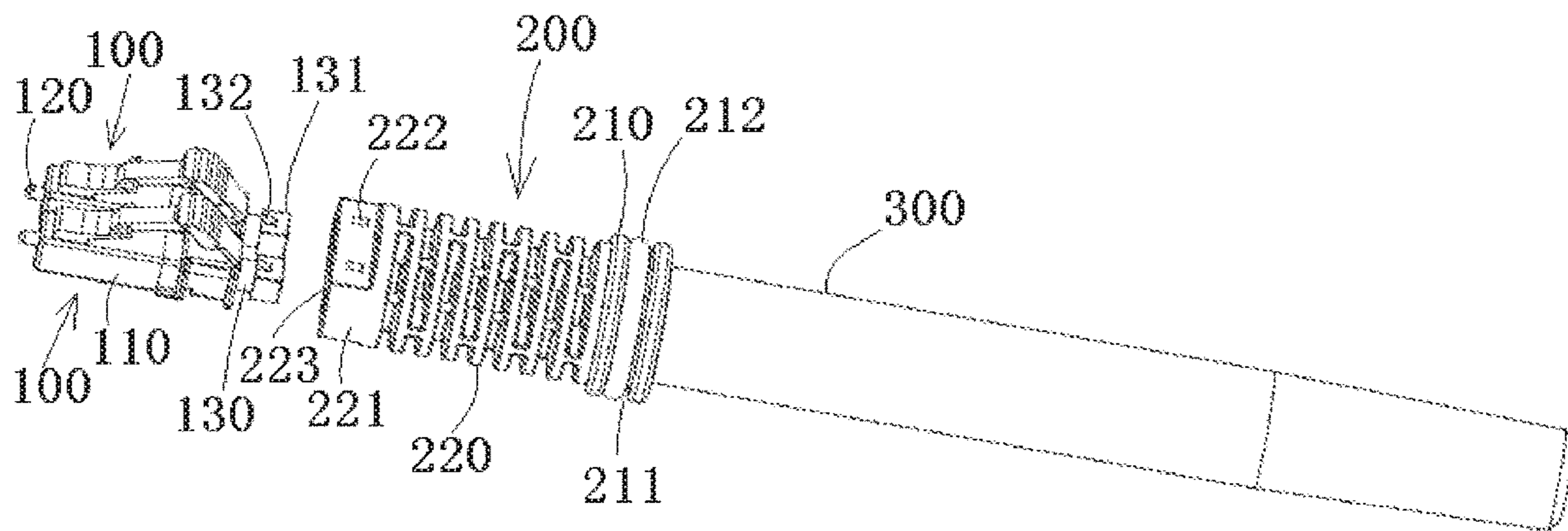


Fig. 1

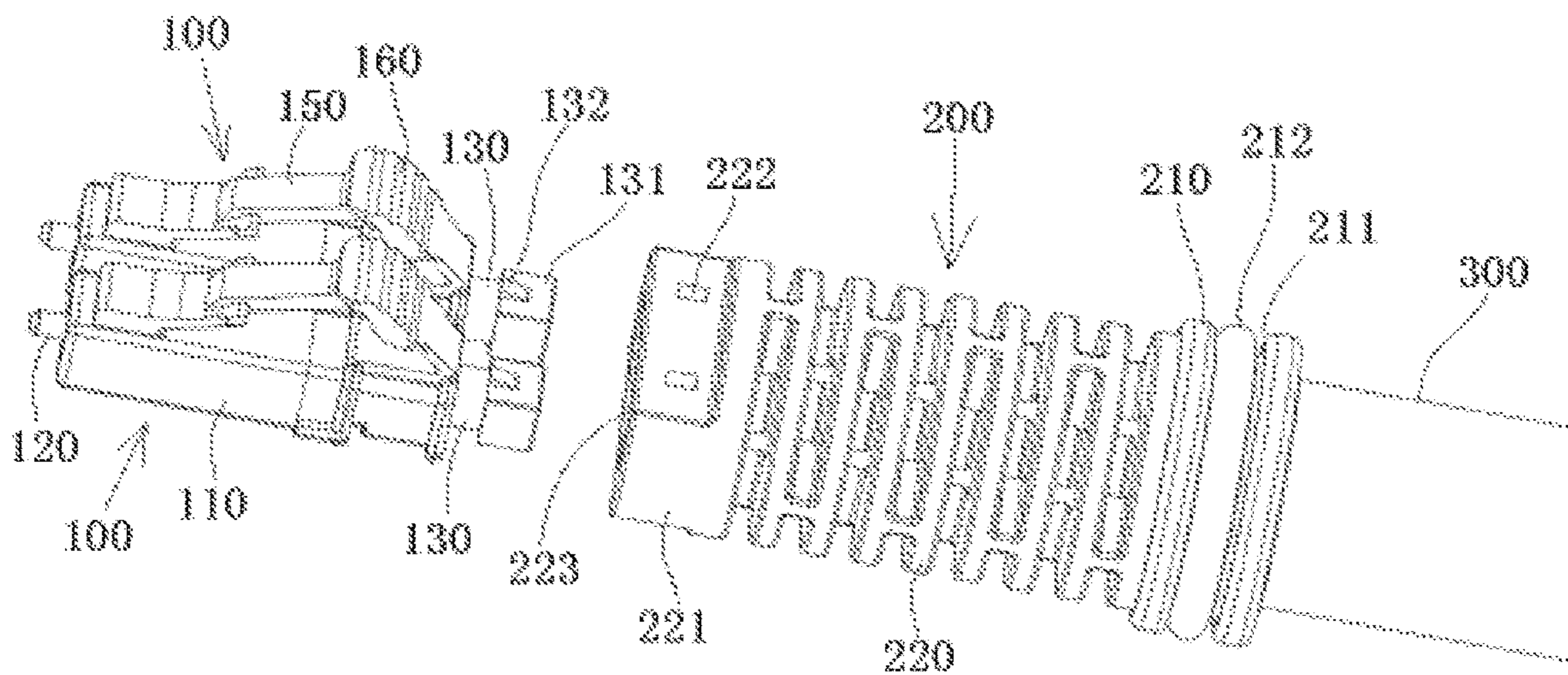


Fig. 2

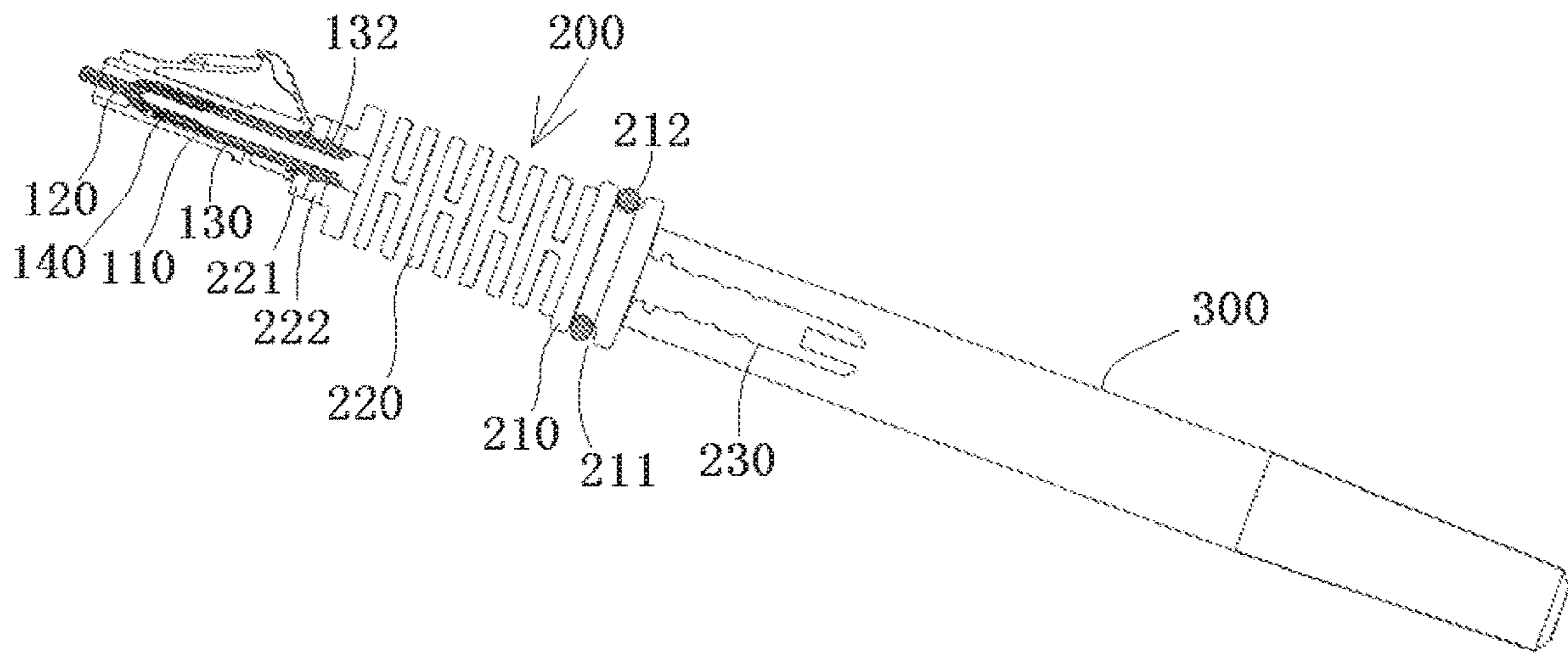


Fig. 3

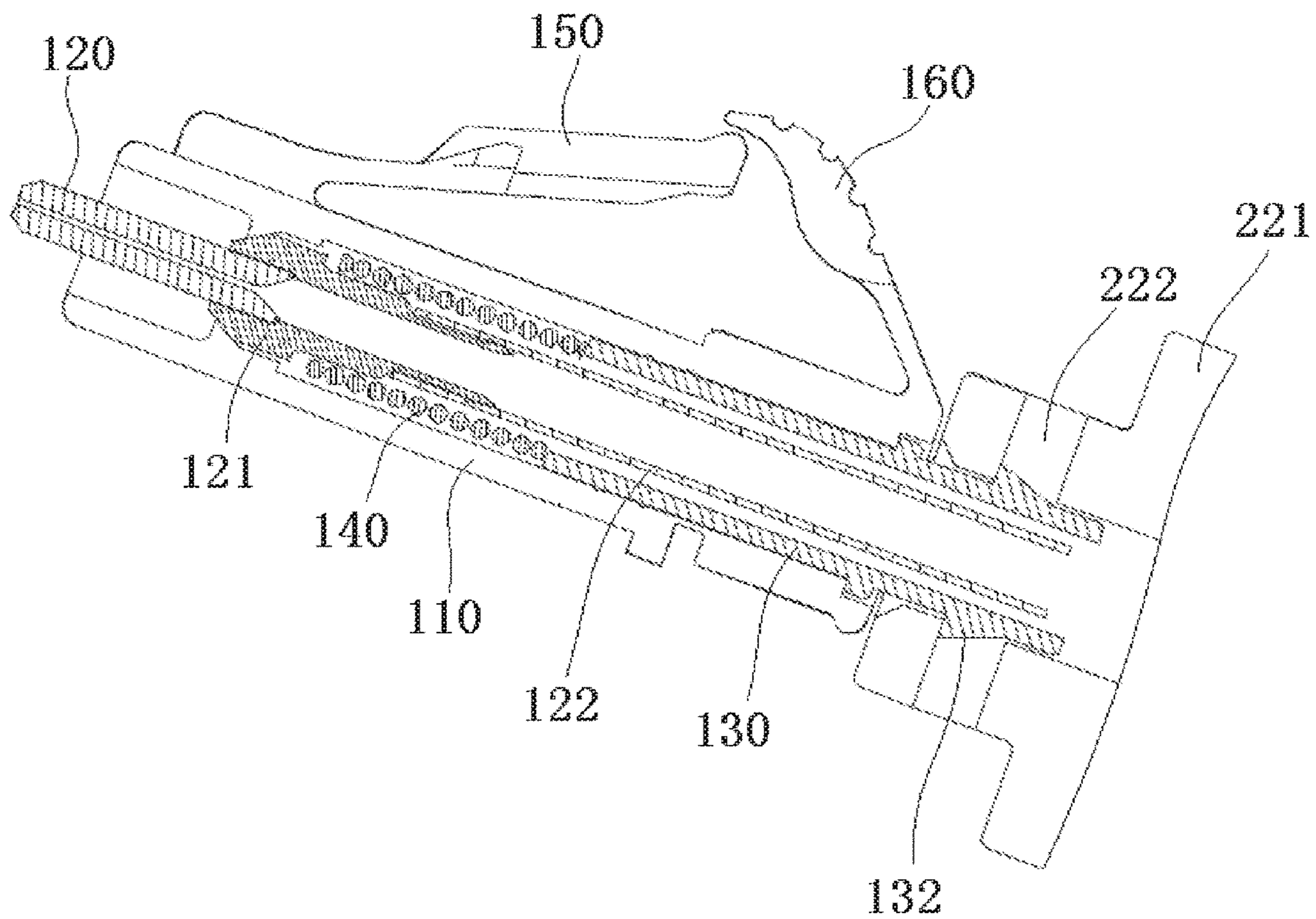


Fig. 4

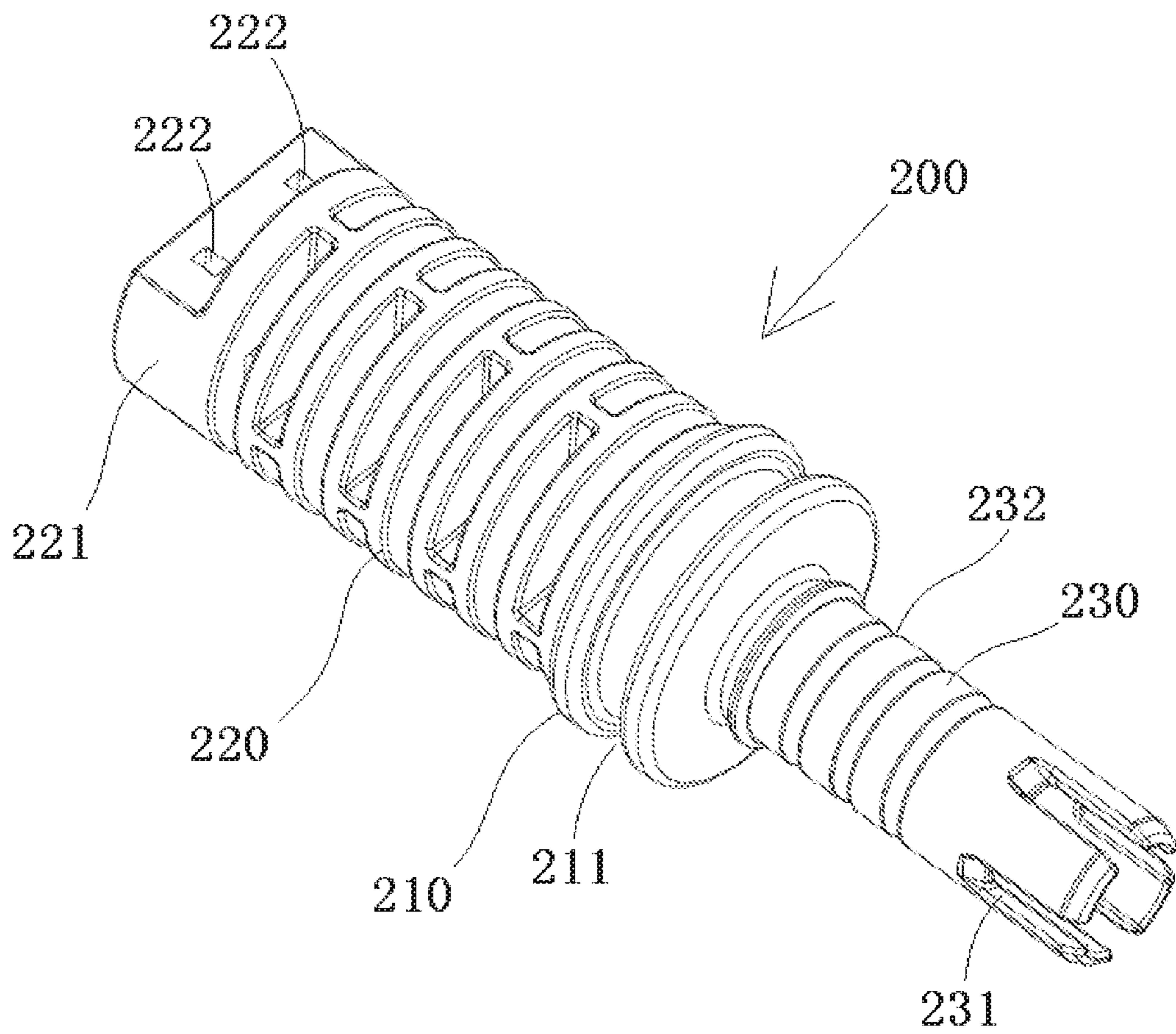


Fig. 5

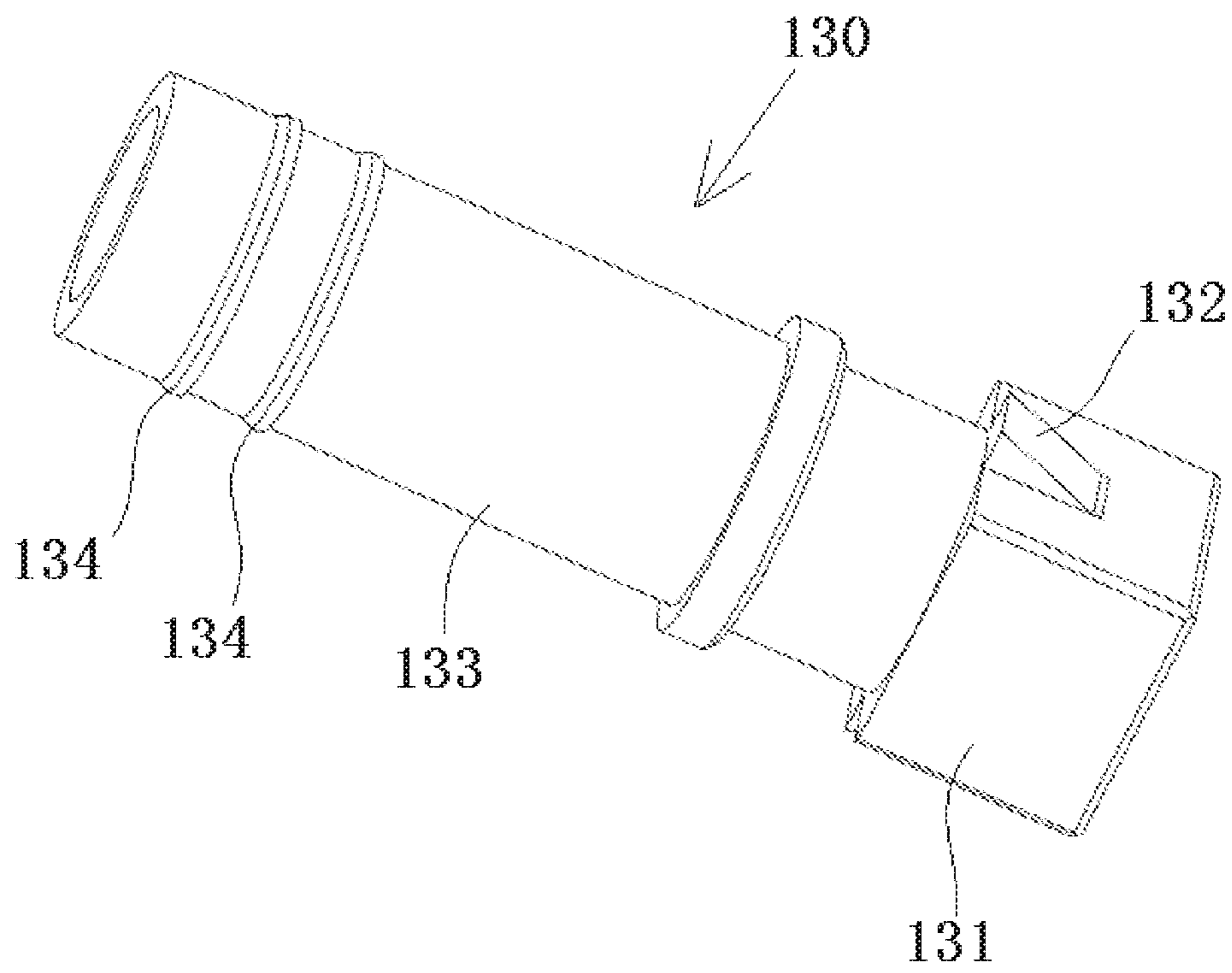


Fig. 6

1**CONNECTOR ASSEMBLY****CROSS-REFERENCE TO RELATED APPLICATION**

This application claims the benefit of the filing date under 35 U.S.C. § 119(a)-(d) of Chinese Patent Application No. 201910522567.8, filed on Jun. 17, 2019.

FIELD OF THE INVENTION

The present invention relates to a connector assembly and, more particularly, to a connector assembly including a connector and a fixing device.

BACKGROUND

An optical fiber connector assembly generally includes a plurality of LC type optical fiber connectors, a flexible protection member, and a fixing seat. The flexible protection member usually includes two flexible half bodies, which are adapted to be assembled together. The front end of each flexible half body is connected to a rear body of the optical fiber connector in a snap-fit manner, and a rear end of each flexible half body is connected to the fixing seat in a snap-fit manner. In this way, there are too many connection points on the flexible protection member, and these connection points easily crack during field installation and use.

SUMMARY

A connector assembly includes a connector and a fixing device. The connector has a housing, a ferrule mounted in the housing, and a rear body inserted into a rear end of the housing. The fixing device is connected to the rear body of the connector. The fixing device has a fixture formed in a single integrated piece. The fixture includes a connection part located at a front end of the fixture and configured to be connected to the rear body of the connector and a flexible protection part disposed adjacent to the connection part and configured to protect a cable passing therethrough.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by way of example with reference to the accompanying Figures, of which:

FIG. 1 is an exploded perspective view of a connector assembly according to an embodiment;

FIG. 2 is an enlarged view of a portion of the connector assembly shown in FIG. 1;

FIG. 3 is a sectional side view of the connector assembly of FIG. 1;

FIG. 4 is an enlarged view of a portion of the connector assembly shown in FIG. 3;

FIG. 5 is a perspective view of a fixing seat of the connector assembly of FIG. 1; and

FIG. 6 is a perspective view of a rear body of a connector of the connector assembly of FIG. 1.

DETAILED DESCRIPTION OF THE EMBODIMENT(S)

Exemplary embodiments of the present disclosure will be described hereinafter in detail with reference to the attached drawings, wherein like reference numerals refer to like elements. The present disclosure may, however, be embodied in many different forms and should not be construed as

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being limited to the embodiment set forth herein; rather, these embodiments are provided so that the present disclosure will convey the concept of the disclosure to those skilled in the art.

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

A connector assembly according to an embodiment, as shown in FIGS. 1 and 2, includes a connector 100 and a fixing device 200, 300. In the shown embodiment, the connector assembly includes two connectors 100, but the present disclosure is not limited to this, and the connector assembly may include one, three, four or more connectors 100.

Each connector 100, as shown in FIGS. 1-4, includes a housing 110, a ferrule 120 mounted in the housing 110, and a rear body 130 inserted into a rear end of the housing 110. In an embodiment, the connector 100 may be an optical fiber connector suitable for connecting with an optical fiber of an optical cable. The optical cable may comprise at least one optical fiber, and the at least one optical fiber of the optical cable may be connected to the at least one connector, respectively. In an embodiment, the connector 100 may be an LC or other type of optical fiber connector.

The fixing device 200, 300, as shown in FIGS. 1-4, is connected to the rear body 130 of each connector 100, and is configured to fix reinforcing elements of a cable (not shown, for example, an optical cable). In an embodiment, the reinforcing elements of the cable may be Kevlar fibers or other type of reinforcing elements.

The fixing device 200, 300, as shown in FIGS. 1-4, has a single integrated or one-piece fixture 200. The fixture 200 includes a connection part 221, a fixing seat 210, 230, and a flexible protection part 220. The connection part 221 is located at a front end of the fixture 200 and configured to be connected to the rear body 130 of each connector 100. The fixing seat 210, 230 is located at a rear end of the fixture 200 and configured to fix reinforcing elements of the cable. The flexible protection part 220 is disposed adjacent to the connection part 221 and configured to protect a cable passing through the flexible protection part 220.

As shown in FIGS. 1-4, in an embodiment, when an axial pulling force is applied to the optical cable, the axial pulling force will be transmitted to the housing 110 of the connector 100 via the fixture 200 and the rear body 130, so as to avoid the axial pulling force from being transmitted to the optical fiber of the optical cable. When a lateral pulling force directed in a radial direction is applied to the cable, the lateral pulling force causes the flexible protection part 220 to deform elastically, so as to prevent the cable from being over bent (if a bending radius of the cable is less than the allowable minimum bending radius, the fiber will be damaged).

In an embodiment, the fixture 200 may be a single molded piece molded from a thermoplastic material. The flexible protection part 220 may be formed with a hollow structure, so that the flexible protection part 220 has a predetermined flexibility. The connection part 221 is adapted to be connected to the rear body 130 of each connector 100 in a snap-fit manner.

As shown in FIGS. 1 and 2, in an embodiment, an insertion chamber 223 is formed in the connection part 221,

and a rear end part **131** of the rear body **130** is adapted to be inserted into the insertion chamber **223** of the connection part **221**. Exemplarily, a slot **222** is formed in a side wall of the insertion chamber **223**, and a protrusion **132** is formed on the rear end part **131** of the rear body **130**. When the rear end part **131** of the rear body **130**, shown in FIG. 6, is inserted into the insertion chamber **223** of the connection part **221**, the protrusion **132** of the rear body **130** is latched into the slot **222**. In an embodiment, the protrusion **132** on the rear body **130** is in the form of barb to prevent the protrusion **132** from separating from the slot **222**.

As shown in FIGS. 1-3 and 5, the fixing seat **210**, **230** includes a seat body part **210** and a tail pipe part **230**. The seat body part **210** is connected to a rear end of the flexible protection part **220**. The tail pipe part **230** is connected to a rear end of the seat body part **210**. The reinforcing elements of the cable may be fixed on the tail pipe part **230**.

As shown in FIGS. 1-3 and 5, the seat body part **210** is formed with a ring of groove **211**, and an elastic sealing ring **212** is arranged in the groove **211**. The connector assembly is adapted to be inserted into an optical fiber adapter (not shown). The elastic sealing ring **212** is used to realize the sealing between the connector assembly and the optical fiber adapter. The connector **100** of the connector assembly of the present disclosure is suitable for docking with a connector of another connector assembly (not shown) through the optical fiber adapter.

As shown in FIGS. 3 and 5, in an embodiment, a plurality of notches **231** are formed on the rear end of the tail pipe part **230**, and the notches **231** are evenly distributed around the circumference of the tail pipe part **230**. The reinforcing elements of the cable are divided into multiple strands. Each strand of reinforcing elements passes through the corresponding notch **231** of the tail pipe part **230** and is evenly laid on the outer wall of the tail pipe part **230**.

The fixture **200**, **300** further comprises a fixing sleeve **300**, shown in FIGS. 1-3, which is wrapped on the tail pipe part **230** of the fixing seat **210**, **230**, so as to hold the reinforcing elements of the cable on the tail pipe part **230**. In an embodiment, the fixing sleeve **300** is a molded piece molded over the tail pipe part **230** on which the reinforcing elements have been laid. As shown in FIG. 5, at least one circumferential groove **232** is formed on the tail pipe part **230** to enhance the jointing force between the fixing sleeve **300** and the tail pipe part **230**.

The rear body **130**, as shown in FIGS. 1-4 and 6, includes a tubular main body **133** adapted to be inserted into the housing **110**. At least one circumferential convex ring **134** is formed on an outer wall of the tubular main body **133**. At least one circumferential annular groove is formed in the inner wall of the housing **110**. When the tubular main body **133** of the rear body **130** is inserted into the housing **110**, the convex ring **134** is engaged with the annular groove to connect the rear body **130** to the housing **110**.

As shown in FIG. 4, in an embodiment, each connector **100** has a tail seat **121** and a spring **140** received in the housing **110**. The tail seat **121** is connected to a rear end of the ferrule **120**. The spring **140** is compressed between the tail seat **121** and the rear body **130** to apply an axial thrust to the ferrule **120**.

As shown in FIG. 4, in an embodiment, each connector **100** further comprises a guide sleeve **122** received in the housing **110**. The guide sleeve **122** is connected to the rear end of the tail seat **121**. A central axis of the guide sleeve **122** is aligned with a central axis of the ferrule **120**, so as to guide the optical fiber of the optical cable which passes through the guide sleeve **122** into an optical fiber jack of the ferrule **120**.

As shown in FIGS. 2 and 4, an elastic latch **150** is provided on the housing **110** of each connector **100**. The elastic latch **150** is adapted to be locked to an optical fiber adapter, so as to fix the connector **100** to the optical fiber adapter. An unlocking arm **160** is provided on the housing **110** of each connector **100**. The elastic latch **150** can be separated from the optical fiber adapter by pressing the unlocking arm **160**.

In various exemplary embodiments of the present disclosure, since the connection part **221** for connecting the rear body **130** of the connector **100** and the flexible protection part **220** for protecting the cable are made into a single integrated or one-piece fixture, there is no connection point between the connection part **221** and the flexible protection part **220**. In this way, it may effectively avoid the cracking of the flexible protection part **220** in the process of installation and use.

It should be appreciated for those skilled in this art that the above embodiments are intended to be illustrative, and not restrictive. For example, many modifications may be made to the above embodiments by those skilled in this art, and various features described in different embodiments may be freely combined with each other without conflicting in configuration or principle. Although several exemplary embodiments have been shown and described, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

As used herein, an element recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural of said elements or steps, unless such exclusion is explicitly stated. Furthermore, references to "one embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising" or "having" an element or a plurality of elements having a particular property may include additional such elements not having that property.

What is claimed is:

1. A connector assembly, comprising: a connector including a housing, a ferrule mounted in the housing, and a rear body inserted into a rear end of the housing; and a fixing device connected to the rear body of the connector, the fixing device has a fixture formed in a single integrated piece, the fixture includes a connection part located at a front end of the fixture and configured to be connected to the rear body of the connector and a flexible protection part disposed adjacent to the connection part and configured to protect a cable passing therethrough;

wherein the fixture has a fixing seat located at a rear end of outer surface of the fixture and configured to fix a plurality of reinforcing elements of an optical cable.

2. The connector assembly according to claim 1, wherein the connection part is adapted to be connected to the rear body of the connector in a snap-fit manner.

3. The connector assembly according to claim 2, wherein an insertion chamber is formed in the connection part, and a rear end part of the rear body is adapted to be inserted into the insertion chamber of the connection part, a slot is formed in a side wall of the insertion chamber and a protrusion is formed on the rear end part of the rear body, the protrusion of the rear body is latched into the slot in response to the rear end part of the rear body being inserted into the insertion chamber of the connection part.

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4. The connector assembly according to claim 3, wherein the protrusion on the rear body is a barb preventing the protrusion from separating from the slot.

5. The connector assembly according to claim 1, wherein the fixing seat has a seat body part and a tail pipe part, the seat body part is connected to a rear end of the flexible protection part, the tail pipe part is connected to a rear end of the seat body part, and the reinforcing elements are fixed on the tail pipe part.

6. The connector assembly according to claim 5, wherein a ring of groove is formed on the seat body part and an elastic sealing ring is arranged in the groove, the connector assembly is adapted to be inserted into an optical fiber adapter and the elastic sealing ring seals between the connector assembly and the optical fiber adapter.

7. The connector assembly according to claim 5, wherein a plurality of notches are formed on the rear end of the tail pipe part, the notches are evenly distributed around a circumference of the tail pipe part, the reinforcing elements of the optical cable are divided into multiple strands, each strand of reinforcing elements passes through one of the notches of the tail pipe part and is evenly laid on an outer wall of the tail pipe part, the fixture has a fixing sleeve wrapped on the tail pipe part to hold the reinforcing elements on the tail pipe part.

8. The connector assembly according to claim 7, wherein the fixing sleeve is a molded piece molded on the tail pipe part on which the reinforcing elements have been laid.

9. The connector assembly according to claim 8, wherein a circumferential groove is formed on the tail pipe part to enhance a jointing force between the fixing sleeve and the tail pipe part.

10. The connector assembly according to claim 1, wherein the connector includes a tail seat and a spring received in the housing, the tail seat is connected to a rear end of the ferrule, and the spring is compressed between the tail seat and the rear body to apply an axial thrust to the ferrule.

11. The connector assembly according to claim 10, wherein the connector includes a guide sleeve received in the housing, the guide sleeve is connected to a rear end of the tail seat, a central axis of the guide sleeve is aligned with a central axis of the ferrule to guide the optical fiber of the optical cable which passes through the guide sleeve into an optical fiber jack of the ferrule.

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12. The connector assembly according to claim 2, wherein an elastic latch is provided on the housing, the elastic latch is adapted to be locked to an optical fiber adapter to fix the connector to the optical fiber adapter.

13. The connector assembly according to claim 12, wherein an unlocking arm is provided on the housing, the elastic latch is separated from the optical fiber adapter by pressing the unlocking arm.

14. The connector assembly according to claim 1, wherein the connector is an LC type optical fiber connector.

15. The connector assembly according to claim 1, wherein the connector includes a guide sleeve received in the housing, with the rear body inserted into the rear end of the housing, the guide sleeve having a first end extending from a front of the rear body in a direction toward the ferrule and a second end extending into a rear end part of the rear body, the rear end part being inserted into the connection part of the fixture.

16. The connector assembly according to claim 15, wherein the connector includes a tail seat connected to a rear end of the ferrule, the first end of the guide sleeve connected to a rear end of the tail seat.

17. A connector assembly, comprising:

a connector including a housing, a ferrule mounted in the housing, and a rear body inserted into a rear end of the housing, the rear body includes a tubular main body adapted to be inserted into the housing, a circumferential convex ring is formed on an outer wall of the tubular main body, and a circumferential annular groove is formed on an inner wall of the housing, the circumferential convex ring is engaged with the circumferential annular groove to connect the rear body to the housing when the tubular main body of the rear body is inserted into the housing; and

a fixing device connected to the rear body of the connector, the fixing device has a fixture formed in a single integrated piece, the fixture includes a connection part located at a front end of the fixture and configured to be connected to the rear body of the connector and a flexible protection part disposed adjacent to the connection part and configured to protect a cable passing therethrough.

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